WHAT IS CLAIMED IS:

1. A method, comprising:

providing a superconducting material having a plurality of pinning sites comprising doped particles operable to pin a magnetic vortex in the superconducting material when the magnetic vortex is in close proximity to the pinning site; and

pinning one or more magnetic vortices at one or more of the pinning sites.

2. The method of Claim 1, further comprising:

detecting a position for each pinning site at which one of the magnetic vortices is pinned; and

interpreting the positions as stored information.

3. The method of Claim 1, wherein the superconducting material comprises a thin film having a thickness of at least several superconducting coherence lengths.

4. The method of Claim 3, wherein the thin film is formed using radio frequency magnetron sputtering.

5. The method of Claim 1, wherein the superconducting material is Bi-(Pb)-Sr-Ca-Cu-O.

6. The method of Claim 1, wherein the pinning sites comprise doped atoms in the superconducting material.

7. The method of Claim 6, wherein the doped atoms are selected from the group consisting of: manganese, vanadium, uranium and hafnium.

8. The method of Claim 1, wherein the step of pinning one or more magnetic vortices comprises positioning a magnetic tip in sufficiently close proximity to the one or more pinning sites to generate a pinned magnetic vortex at respective ones of the one or more pinning sites.

9. The method of Claim 1, wherein:

each pinned magnetic vortex has a magnetic flux; and

each pinned magnetic vortex is associated with a corresponding pinned magnetic vortex having a magnetic flux in the opposite direction of the flux of the pinned magnetic vortex.

10. The method of Claim 1, wherein:

each pinned magnetic vortex has a magnetic flux at a first exit point;

each pinned magnetic vortex has a corresponding magnetic flux at a second exit point in the opposite direction of the magnetic flux at the first exit point of the pinned magnetic vortex such that a closed loop of magnetic field lines is formed outside of the superconducting material.

11. The method of Claim 9, wherein the pinned magnetic vortices are associated with the corresponding pinned magnetic vortices such that the net magnetic flux of the superconducting material is zero or nearly zero.

12. The method of Claim 9, further comprising detecting the position of a dipole formed by the pinned magnetic vortex and the corresponding pinned magnetic vortex by detecting a magnetic field gradient between the pinned magnetic vortex and the corresponding magnetic vortex.

13. An information storage apparatus, comprising:

a superconducting material;

a plurality of doped particles within the superconducting material operable to pin one or more magnetic vortices;

a magnetic tip operable to be positioned in sufficiently close proximity to each of the pinning sites to generate a pinned magnetic vortex at the pinning site; and

a magnetic detector operable to detect any magnetic vortices pinned at any of the pinning sites.

14. The apparatus of Claim 13, wherein the doped particles comprise doped atoms.

15. The apparatus of Claim 13, wherein the superconducting material comprises a thin film having a thickness of at least several superconducting coherence lengths.

16. The apparatus of Claim 15, wherein the thin film is formed using radio frequency magnetron sputtering.

17. The apparatus of Claim 13, wherein the superconducting material is Bi-(Pb)-Sr-Ca-Cu-O.

18. The apparatus of Claim 13, wherein:

each pinned magnetic vortex has a magnetic flux; and

each pinned magnetic vortex is associated with a corresponding pinned magnetic vortex having a magnetic flux in the opposite direction of the flux of the pinned magnetic vortex.

19. The apparatus of Claim 13, wherein:

each pinned magnetic vortex has a magnetic flux at a first exit point; and

each pinned magnetic vortex has a corresponding magnetic flux at a second exit point in the opposite direction of the magnetic flux at the first exit point of the pinned magnetic vortex such that a closed loop of magnetic field lines is formed outside of the superconducting material.

20. The apparatus of Claim 18, wherein the pinned magnetic vortices are associated with the corresponding pinned magnetic vortices such that the net magnetic flux of the superconducting material is zero or nearly zero.

21. The apparatus of Claim 18, wherein the detector is operable to detect the pinned magnetic vortices by detecting the position of a dipole formed by the pinned magnetic vortex and the corresponding pinned magnetic vortex by detecting a magnetic field gradient between the pinned magnetic vortex and the corresponding magnetic vortex.

22. Information embodied as magnetic vortices in a superconducting material, comprising:

a plurality of pinning sites in a superconducting material operable to pin a magnetic vortex in close proximity to the pinning site within the superconducting material; and

one or more of the magnetic vortices pinned at one or more of the pinning sites.

23. The information of Claim 22, wherein the pinning sites comprise impurity atoms doped in the superconducting material.

24. A method for reading stored information in a superconducting material, comprising:

providing a superconducting material having pinning sites, each pinning site operable to pin a magnetic vortex in close proximity to the pinning site; and

detecting any pinned magnetic vortices at any of the pinning sites.

25. The method of Claim 24, wherein the step of detecting comprising:

positioning a magnetic force microscope comprising a cantilever and a magnetic tip in close proximity to one of the pinning sites; and

detecting any deflection in the cantilever.